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QUATERNARY EVOLUTION OF THE MONTEREALE INTERMOUNTAIN BASIN (CENTRAL APENNINES): KNOWLEDGE AND OPEN QUESTIONS

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ABSTRACT: Chiarini E. & La Posta E., *Quaternary evolution of the Montereale intermountain basin (Central Apennines): knowledge and open questions.* (IT ISSN 0394-3356, 2011)
New data collected for the "Antrodoco" 348 Sheet of the Geological Map of Italy at 1:50,000 scale permit the characterization of sedimentary events that have interested the Montereale intermountain basin (AQ) and the formulation of hypothesis on its Quaternary evolution.

RIASSUNTO: Chiarini E. & La Posta E., Evoluzione quaternaria del bacino intermontano di Montereale (Appennino centrale): stato delle conoscenze e problemi aperti. (IT ISSN 0394-3356, 2011)
I nuovi dati raccolti per la realizzazione del Foglio 348 "Antrodoco" della Carta geologica d'Italia alla scala 1:50.000 permettono di caratterizzare gli eventi sedimentari che hanno interessato il bacino intermontano di Montereale (AQ) nel corso del Quaternario e di formulare delle ipotesi sulla sua evoluzione.

Key words: geologic mapping, quaternary faults, stratigraphic log, lacustrine deposits.

Parole chiave: cartografia geologica, faglie quaternarie, log stratigrafico, depositi lacustri.

1. INTRODUCTION

The Montereale depression - the northernmost branch of the Aterno catchment basin - is characterized by drainage difficulties and during the historical time was the site of a shallow lake (V. DE VECCHIS, pers. com.). Its tectonic origin is widely accepted (BLUMETTI, 1991; BAGNAIA *et al*., 1996; GALADINI *et al*., 2000; GALADINI & MESSINA, 2001; 2004), although its evolution is almost unknown.
The study of this intermountain basin is part of the ongoing research activity related to the "Antrodoco" 348 Sheet of the Geological Map of Italy (1:50,000 scale). This paper reports on the results obtained through the geological and geomorphological analyses of Quaternary deposits; the preliminary data of three stratigraphic logs obtained with a drilling survey are also discussed. The aim of the research is to provide new data on a poorly studied intermountain basin, that could improve the knowledge of the tectonic structures within a sector of the Central Apennines, characterized by a high seismicity testified by violent earthquakes during historical periods (BLUMETTI, 1995).

2. GEOLOGICAL SETTING AND AVAILABLE DATA

In this area a thrust front places the Gran Sasso Unit (made up of Triassic-Miocene mainly carbonate succession) on the Laga Unit (Upper Tortonian-Lower Messinian turbidite deposits). The two units have been involved in the extensional phase since the early Pleistocene. A normal fault system with an en-echelon pattern has been recognized within the sector of the upper Aterno valley (GALADINI & GALLI, 2000; GALADINI *et al*., 2000). Evidences of Quaternary activity in the northernmost segments of the system are represented by the Capitignano fault and the S. Giovanni fault (BASILI, 1999; BONCIO *et al.*, 2004; GALADINI & GALLI, 2000; GALADINI *et al*., 2000). The role of the Capitignano fault in the Quaternary evolution of the basin has been underlined by many authors (BAGNAIA *et al*., 1996; GALADINI *et al*., 2000; GALADINI & MESSINA, 2001, 2004).
The structural setting of the neighbouring areas and preliminary investigations of the Bouguer anomaly trends (FERRI *et al*., 2010) suggest the presence of two different depocentres: one corresponds to the topographically most depressed area, near the Piedicolle inhabited zone, and another is situated at the foot of the north-eastern slope, in the hanging wall of the Capitignano fault. Drilling and geoelectric data acquired by ENEL (1969) in a study for the realization of an hydroelectric basin, allow to establish that the thickness of sediments at the mouth of the T. Mozzano valley reaches 140 m. Moreover, stratigraphy of an in-depth drilling, recovered from the Italian Geological Survey (L. 464/84), indicates a thickness of at least 140 m close to the north-eastern slope, not far away from the Capitignano village.

3. GEOMORPHOLOGICAL AND SURVEY DATA

The relevant morphological characters of the basin are the steep mountain front of M. Civitella – Colle Leone with its evident triangular facets, the almost continuous glacis along the foothills that was formed by the coalescence of talus and alluvial fans and the large alluvial plain of the Aterno River and its tributaries.
The oldest deposits are scarce suspended sediments located along the north-eastern and

southern edges of the basin; they include a paleo-landslide along the right slope of the Mozzano valley (CACCIUNI *et al*., 1995). These deposits have presently no chronological constraints, and are displaced by Quaternary faults and deeply dissected by erosion. Different ratios of embedding relative to paleo-landsurfaces permit to consider them as part of different stratigraphic units. Deposits with well preserved morphologies, cropping out along the north-eastern and southern foothills, can be referred to the late Pleistocene.
The Holocene deposits consist of limited strips of flood terraces, a series of fans with apex embedded within the deposits of the late Pleistocene and alluvial sediments of the present Aterno River plain. Many landslides occurred at the base of the triangular facets on the north-eastern slope and have accumulated within the stream valleys.
Reconstruction of the role of recent active tectonics in evolution of the Capitignano fault is greatly hampered by lithostructural factors (BRANCACCIO *et al*., 1986): on one hand, evident escarpments made up of Laga flysch deposits, could derive from exhumation of older fault escarpments due to selective erosion; on the other hand, the fault escarpments on generic Quaternary deposits, which are visible along the northernmost branch of the fault, are badly preserved. Nevertheless, the consistent thickness of the deposits in the hanging wall of the fault, and the progradation of the Holocene fans relative to the older ones, could be interpreted as geomorphologic clues of recent activity and reduction in time of fault movement rates respectively, according to the criteria defined by SANTANGELO (2003, cum bibl.).
The relations between the outcropping deposits and the S. Giovanni fault are well known thanks to favourable field conditions. In fact, on a newly excavated cross section inside a quarry (near the village of S. Giovanni Paganica) the displacement and intense deformation of upper Pleistocene slope deposits have been observed (CINTI *et al.*, 2010).

4. STRATIGRAPHIC LOGS

In order to reconstruct the stratigraphic framework considering a wider sedimentary record two boreholes (S2-Pratorosolo, depth 65 m and S3-Piedicolle, depth 75 m) were drilled near the western depocentral area. A third borehole (S1-Casci, depth 100 m) has been drilled in the hanging wall of the Capignano fault. Geoelectric survey has been performed to drive the borehole localization.
In the S2 core (Fig. 1) two different depositional phases have been clearly distinguished with specific lithological characters. The basal part consists of etherometric calcareous breccias with subrounded clasts horizons of alluvial or combined alluvial-gravitational origin. These deposits are referable to the sediments cropping out in the area of S. Giovanni Paganica-Castello, attributed to the early Pleistocene (Calabrian) (BASILI, 1999; GALADINI *et al.*, 2000; GALADINI & MESSINA, 2001; 2004). Upward, the coarse sediments are gradually replaced by lacustrine whitish clayey silts and clays; an >3 m thick well-developed paleosol, ochre-like in colour, marks the end of this depositional phase. The deposits lack elements derived from the erosion of the Laga flysch, and the siliceous component mainly consists of quartz grains and siliceous fossils deriving from the erosion of spongolithic limestones from the M. Marine area. From 38 m to the surface an alluvial plain sedimentation, with palustrine episodes, takes place; in these deposits clasts of the Laga

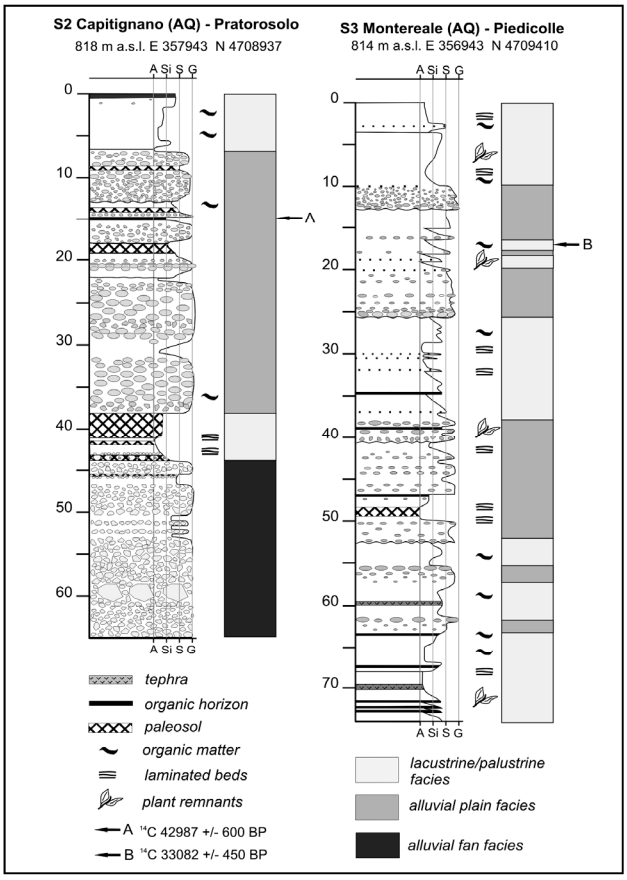

Fig. 1 Stratigraphic logs of S2 and S3 boreholes.
Stratigrafie dei sondaggi S2 ed S3.

flysch formation are frequent.
The succession from the S3 borehole (Fig.1) begins with lacustrine and palustrine deposits, with peaty levels and volcanic horizons and a meter thick brown paleosol. The volcanic ashes, still under examination, can be related to strombolian events from Latium volcanic complexes (B. GIACCIO, pers. com. 2011). Upward, cyclic sequences related to a fluvial and lacustrine environment (prevalence of thin, laminated horizons and peaty levels) occur. The most significant fluvial episode is over 15 meters thick and consists of well sorted sediments with fining upward sequences and palustrine episodes; in the fine grained levels an organic horizon has a radiocarbon AMS age of 33082 +/- 450 yr BP.

The interpretation of the succession drilled in the S1 borehole is quite complex and deserve a more complete analysis. Until now, two main lacustrine phases, separated by thick layers of etherometric sediments with muddy matrix, have been recognized. Coarse sediments are partly referable to gravity flow processes and partly to tractive currents. These high-energy processes could have determined unfavourable conditions for the preservation of volcanic horizons.

5. CONCLUSIONS

The preliminary results of this study provide indications on the sediment source areas and permit to tentatively reconstruct the earliest sedimentary phases that involved the intermountain basin. The breccias drilled in the S2 borehole and the overlying lacustrine sediments testify an early phase during which that sector did not receive the sediment supply from the Laga flysch, cropping out in the northern and eastern areas. A fully-developed soil testifies the end of this phase and indicates a long period of morphological stability. The dubious reference of these events to the early Pleistocene needs to be confirmed.

The presence oh the volcanic horizons enables the preliminary attribution of the deepest sequences drilled in S3 to the middle Pleistocene. The cyclic sequences of fluvial and lacustrine sediments drilled in the S3 borehole are likely controlled by the climatic changes during the middle-late Pleistocene in a subsidence-driven regime. The last significant fluvial phase, including an organic horizon dated 33082 +/- 450 yr BP, has been followed by the marsh-lacustrine sedimentation that has been characterizing the basin until historical times.

The correlation between S1, S2 and S3 cores is hard to establish due to the lack of marker and/or dated horizons at the present state of knowledge. The vertical lithofacies variation of the S2 and S3 cored successions suggests that these two adiacent sectors of the plain, very close and at the same elevation above sea level, had experienced radically different evolutions. The lack of lacustrine sequences and the limited thickness of alluvial deposits in the S2 borehole are relevant findings that could indicate that the two basin sectors were subjected to different vertical movements during the middle-late Pleistocene. However, further elements and in-depth studies are required to support this hypothesis.

In this regard, tephrostratigraphic analyses and new ESR and OSL datings are being established in order to obtain the required chronological constraints and verify those already available. Further checks on the data collected can be carried out through paleomagnetic analysis of the oldest lacustrine deposits of the cores.

Lastly, palynologic and paleobotanic research on the successions can improve the understanding of the prevailing climatic and environmental conditions at the time of sedimentation, and consequently allow a more accurate assessment of the role played by tectonics in the evolution of the basin.

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